

## Periodic Trends Worksheet

*Directions: Use your notes to answer the following questions.*

1. Rank the following elements by increasing atomic radius: carbon, aluminum, oxygen, potassium.
  - Asking to order from smallest to largest.
  - Oxygen, Carbon, Aluminum, Potassium
  
2. Rank the following elements by increasing electron affinity: sulfur, oxygen, neon, aluminum.
  - Asking to order from smallest energy to largest energy.
  - Neon, Aluminum, Oxygen, Sulfur
  
3. Why does fluorine have a higher ionization energy than iodine?
  - Harder to remove a valence electron from fluorine compared to iodine since fluorine has a smaller atomic radius and thus the electrons feel the nuclear effective charge more than the valence electrons in iodine, which are further away from the nucleus.

OR

  - Given that fluorine has a smaller radius than iodine, the protons can exert a greater pull on its valence electrons, making it harder for the electron to be removed.
  
4. Why do elements in the same family generally have similar properties?
  - Elements in the same family generally have similar properties due to the similarities of their electron configuration, particularly the number of electrons in their valence shell. Given that most of the chemistry we observe is due to the valence electrons, it follows that elements in a family generally have similar properties.
  
5. Indicate whether the following properties increase or decrease from left to right across the periodic table.
  - a. atomic radius
    - decreases (the effective nuclear charge increases; protons can exert a greater pull on the valence electrons, reducing the size of the radius)
  
  - b. first ionization energy
    - increases (the radius decreases and thus protons can exert a greater pull on the valence electrons making it harder to remove a valence electron)
  
  - c. electron affinity
    - No clear trend, however, overall it increases (a mixture between the size of the atom and the orbitals)

6. What trend in atomic radius occurs across the periodic table? What causes this trend?
- The atomic radius decreases since the effective nuclear charge increases, allowing the protons to exert a greater pull on the valence electrons, which reduces the size of the radius.
7. What trend in ionization energy occurs across a period on the periodic table? What causes this trend?
- The ionization energy increases since the radius decreases and thus protons can exert a greater pull on the valence electrons, which requires more energy to remove a valence electron.
8. Circle the atom in each pair that has the largest radius.
- **Recall that**
    - 1) Radius increases as we go down a group; larger value of  $n$ , meaning we are adding more energy levels and moving further away from the nucleus.
    - 2) Radius decreases as we move from left to right across a period due to larger  $Z_{\text{eff}}$ , causing the valence electrons to be further pulled towards the nucleus.
- a. Al or B
  - b. Na or Al
  - c. S or O
  - d. O or F
  - e. Br or Cl
  - f. Mg or Ca
9. Circle the atom in each pair that has the greater ionization energy.
- **Recall that**
    - 1) smaller radius: requires more energy to remove a valence electron given the increase in  $Z_{\text{eff}}$  since the valence electrons are further being pulled towards the nucleus.
    - 2) Bigger radius: requires a less energy to remove a valence electron as it is further away from the nucleus and does not feel the  $Z_{\text{eff}}$  as much.
- a. Li or Be
  - b. Ca or Ba
  - c. Na or K.
  - d. P or Ar
  - e. Cl or Si
  - f. Li or K

10. Define electron affinity.

- The change in energy produced when (1 mol) of an electron is added to (1 mol) of an atom in the gaseous state.

11. Circle the atom in each pair that has the higher electron affinity (a greater energy release).

- **Note:** The trends for electron affinity can in part be explained by three factors: (1) effective nuclear charge, (2) atomic radius, and (3) electron shielding (or screening).
  - **Other factors to consider:** stability of adding a new valence electron (completing a full level, completing a full sublevel, forming a half full sublevel, adding an electron in an orbital with an unpaired electron, etc).
- a. Ca or Ga
- b. Br or As
- c. Li or O
- d. Ba or Sr
- e. Cl or S
- f. O or S